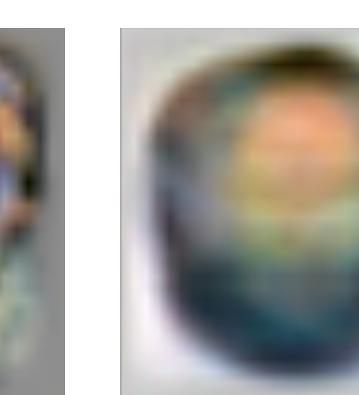
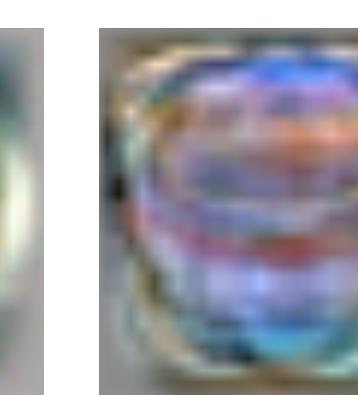
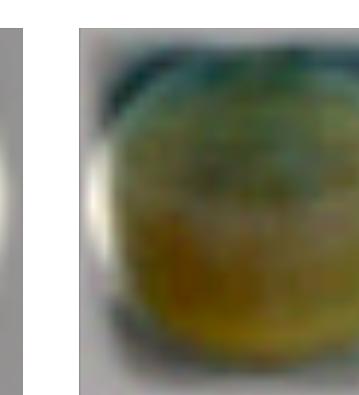
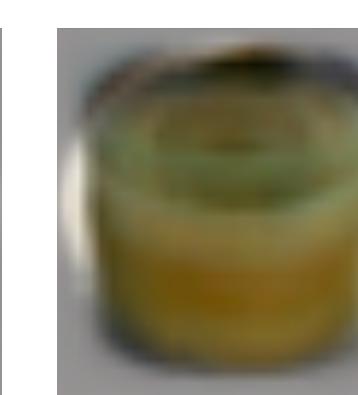
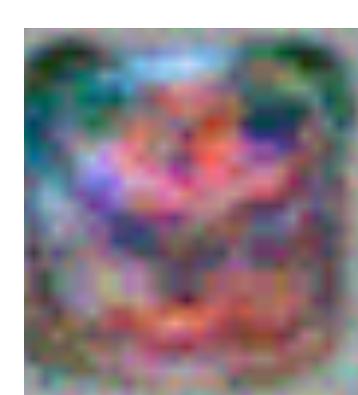
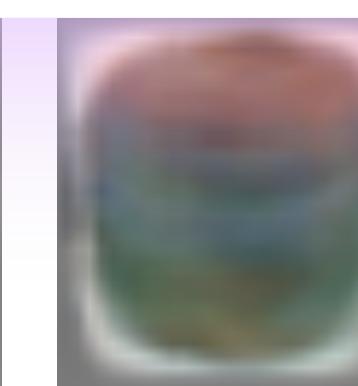
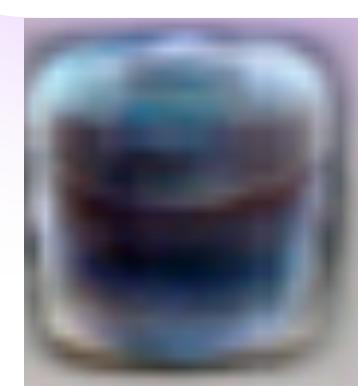
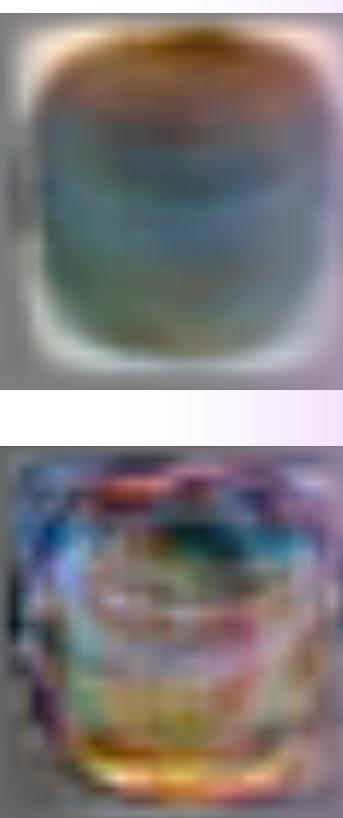


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Discussion 0
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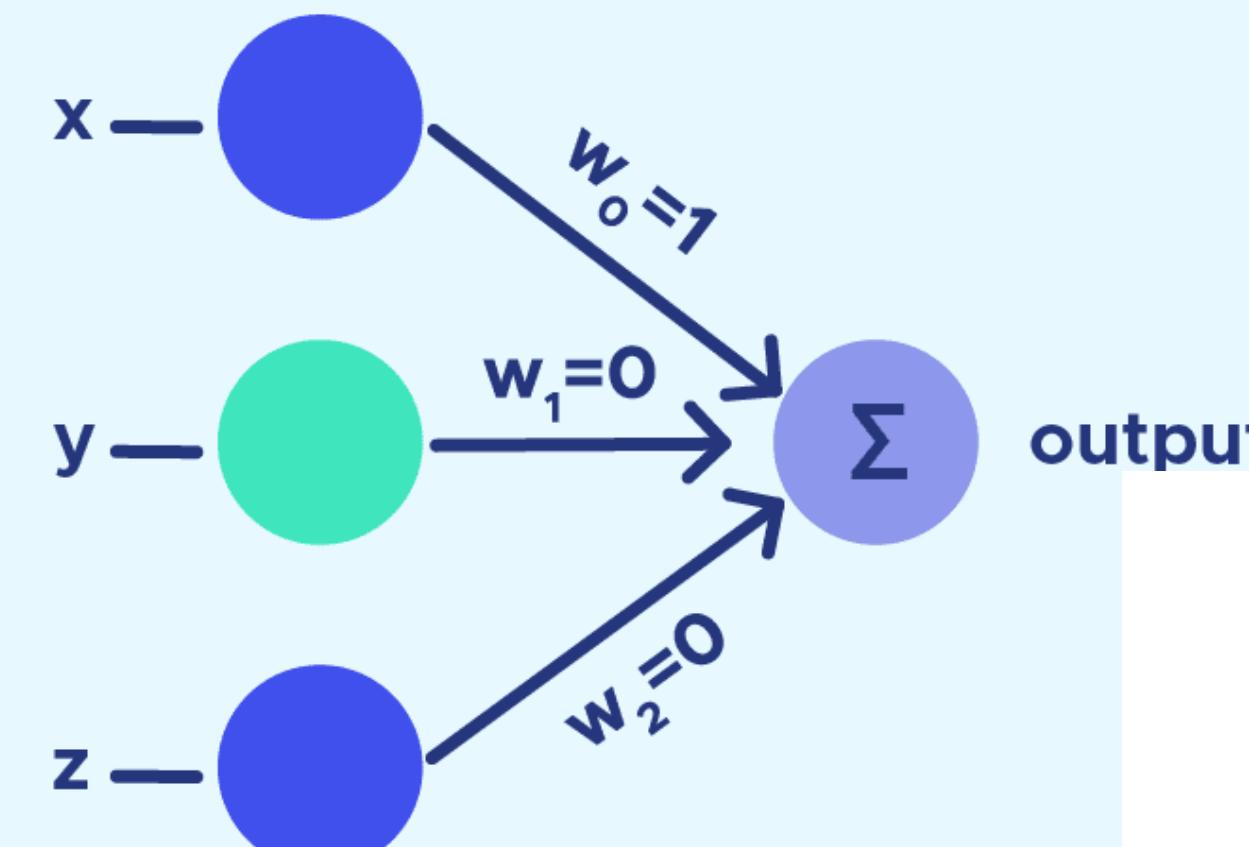


Welcome!

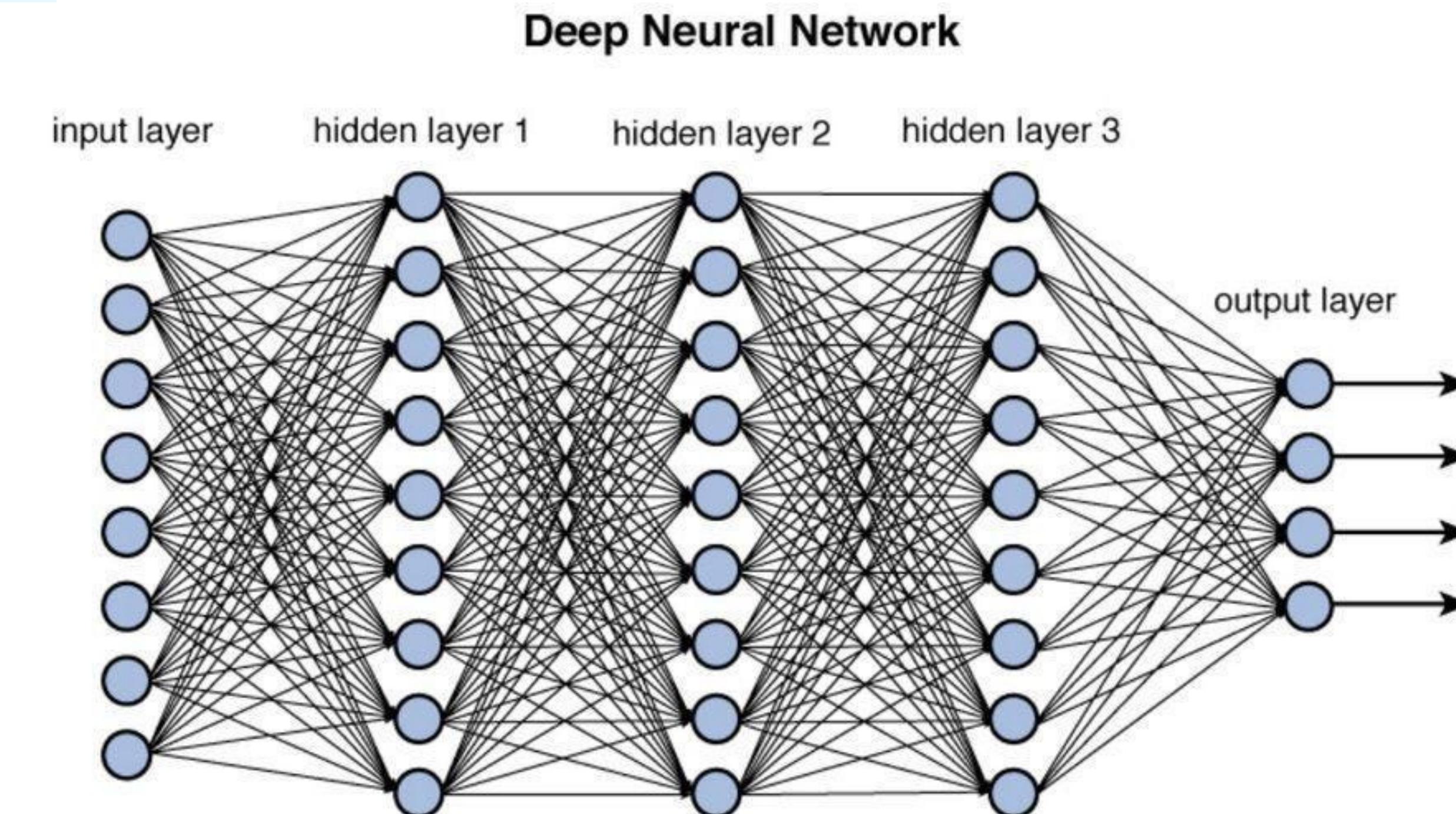




Deep Learning for Robot Perception

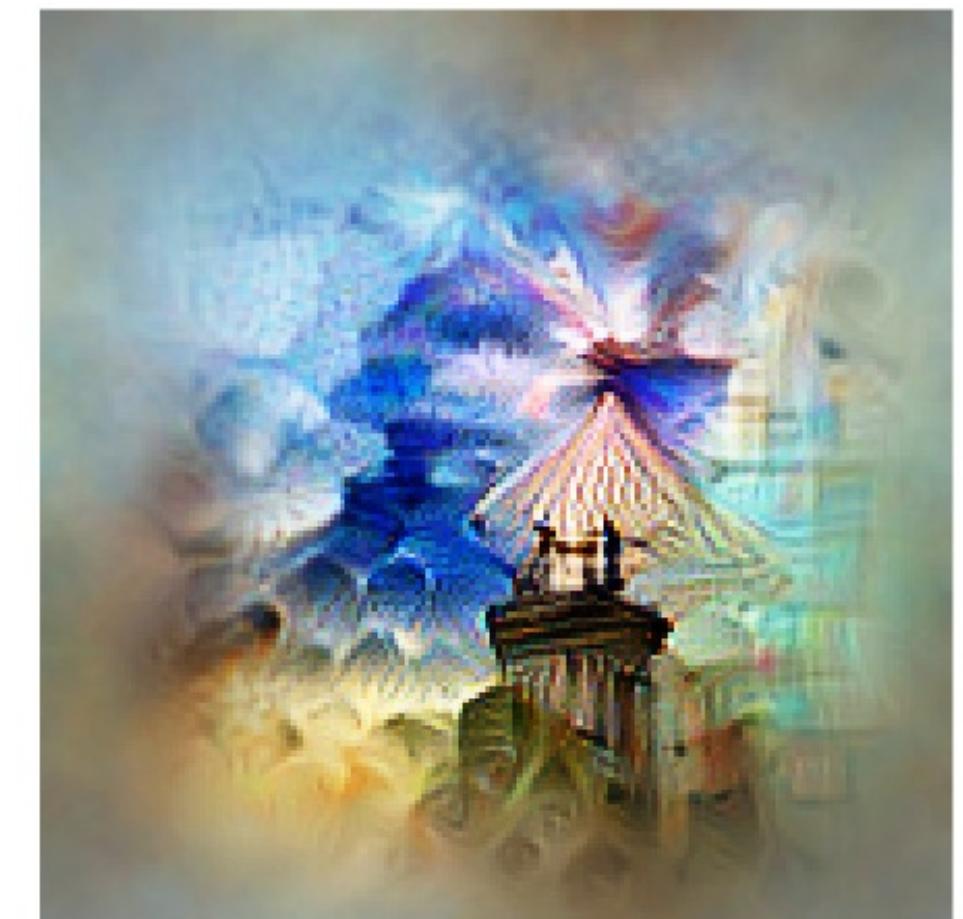
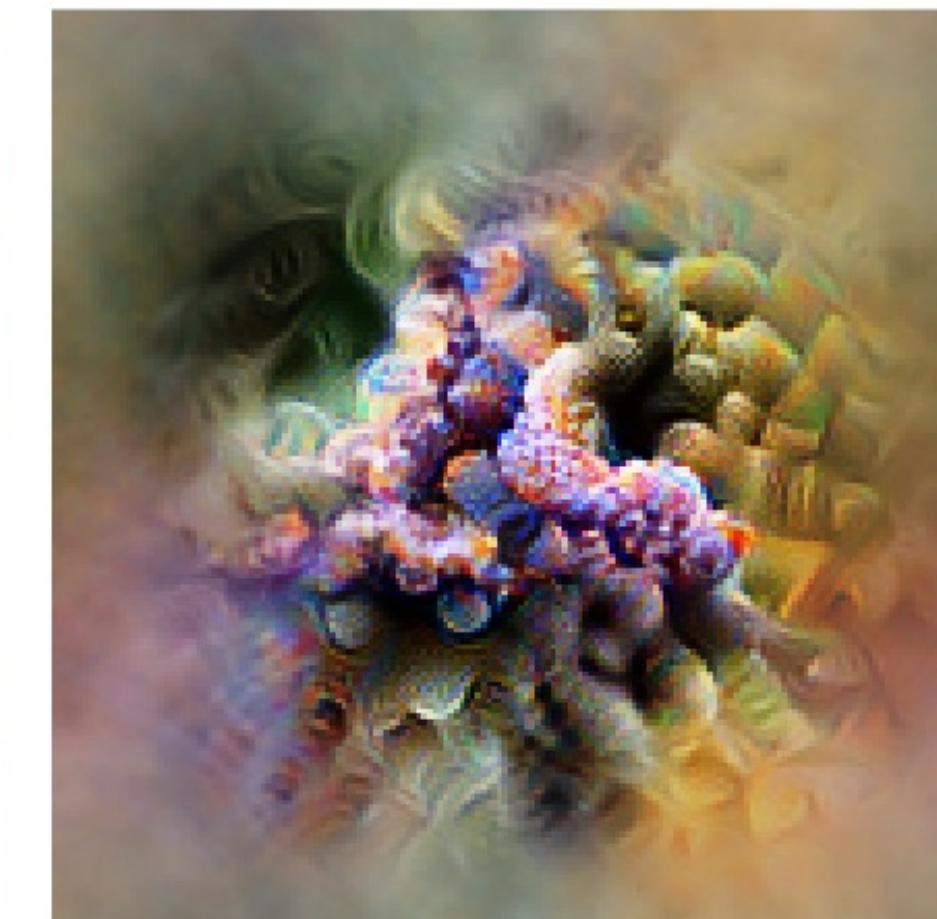
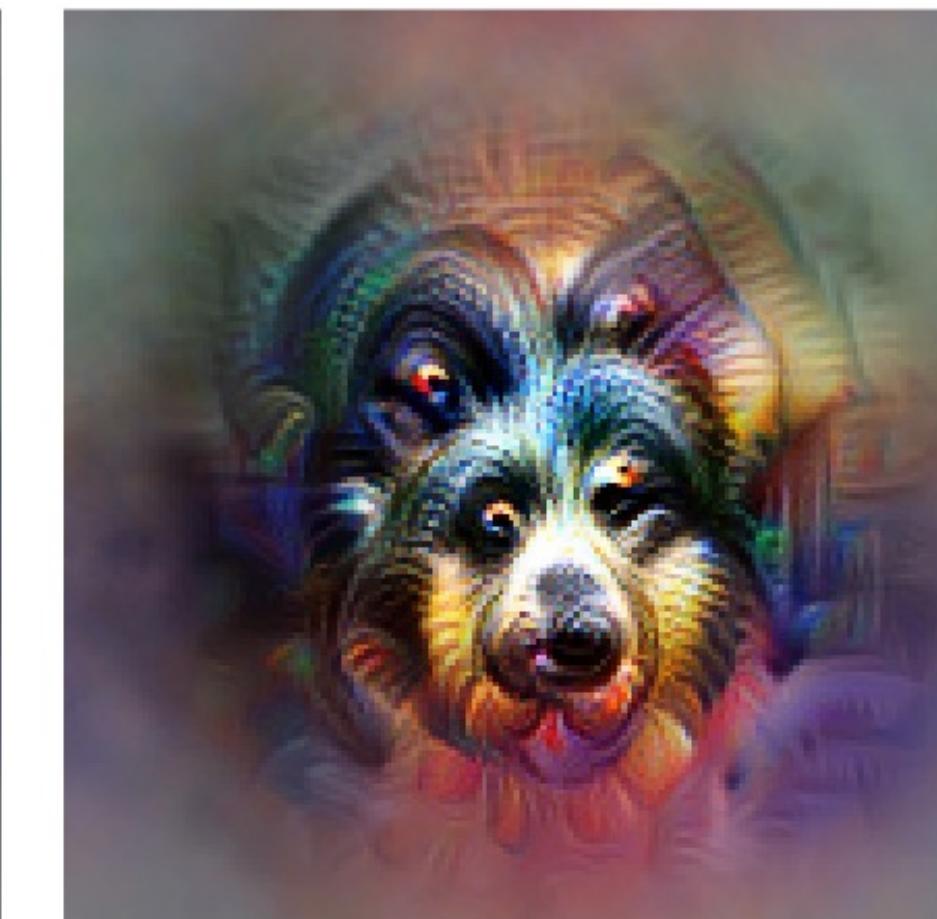
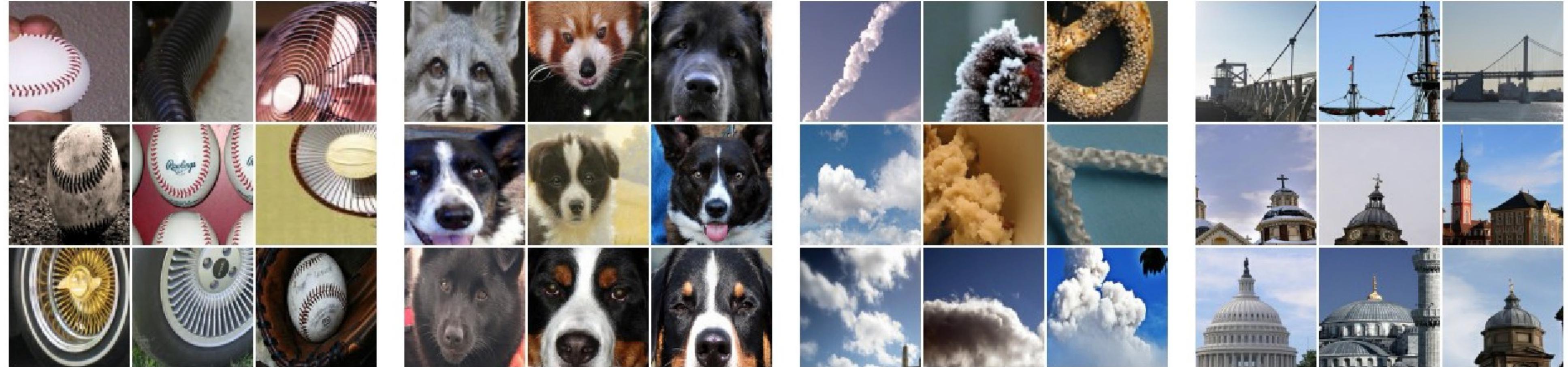


What is Deep Learning?





What is Deep Learning?



Baseball—or stripes?
mixed4a, Unit 6

Animal faces—or snouts?
mixed4a, Unit 240

Clouds—or fluffiness?
mixed4a, Unit 453

Buildings—or sky?
mixed4a, Unit 492



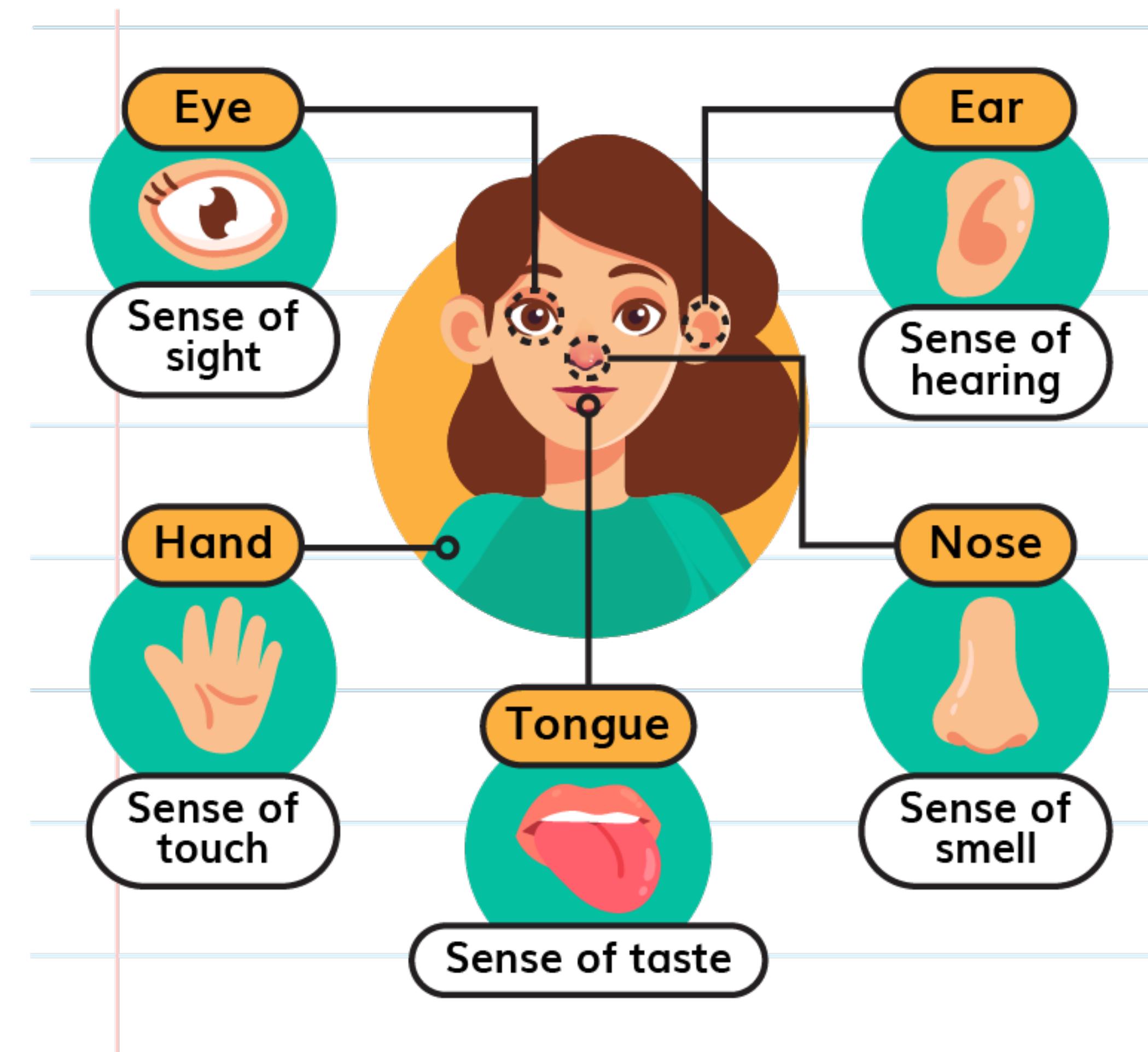
What is Deep Learning?





What is robot perception?

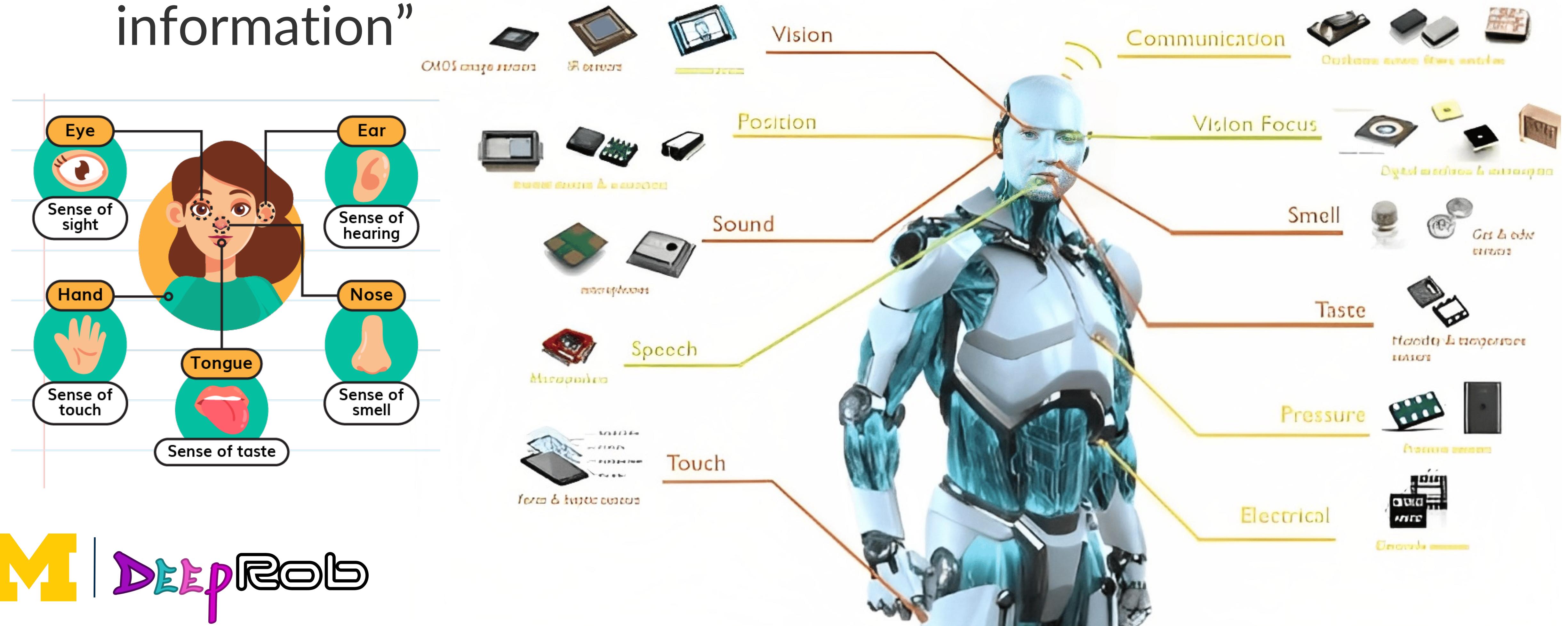
- “Understanding the environment through **sensory** information”





What is robot perception?

- “Understanding the environment through **sensory** information”





Course Staff

Instructor: Dr. Xiaoxiao Du [Sounds like “she-OW she-OW doo”]

- Email: xiaodu@umich.edu
- Office: 3257 FRB; or virtually



Instructor: Anthony Opiari

- Email: topipari@umich.edu

Advising Faculty: Prof. Chad Jenkins

- Email: ocj@umich.edu





Course Staff

GSI: Edmond Tong
ekjt@umich.edu



IA: Dalton Richardson
daltonri@umich.edu



IA: Yifu Lu
yifulu@umich.edu





Course Information

- **Lecture:** Tuesday & Thursday 3:00PM-4:30PM @G906 COOL

Zoom link:

<https://umich.zoom.us/j/96524504025?pwd=R2pKWmVGVUExZCtBUGVWM2dONHFBQT09>

Meeting ID: 965 2450 4025

Passcode: deeprob

- **Lab/Discussion:** Wednesdays 3:30PM-5:30PM @EECS 1311



DeepRob Grading

- Project 0 – 6%
- Project 1 – 12%
- Project 2 – 12%
- Project 3 – 12%
- Project 4 – 12%
- Final Project – 20%
- Participation/16 Pre-Lecture Quizzes – 16% (1% each)
- Student Lab Presentations – 10%

- A+ = 97.0 – 100
- A = 93.0 – 96.9
- A- = 90.0 – 92.9
- B+ = 87.0 – 89.9
- B = 83.0 – 86.9
- B- = 80.0 – 82.9
- C+ = 77.0 -- 79.9
- C = 73.0 – 76.9
- C- = 70.0 – 72.9
- D+ = 67.0 – 69.9
- D = 63.0 – 67.9
- D- = 60.0 – 62.9
- E = 0.0 – 59.9 (Not Passed)



Course Content

- Linear Classifiers
- Training a neural network
- CNN/RNNs (convolutional and recurrent neural networks)
- Object detection
- Semantic scene understanding
- Deep learning datasets and data annotation
- Multi-modal perception
- Frontiers in DL
- And.....
- We welcome your input!



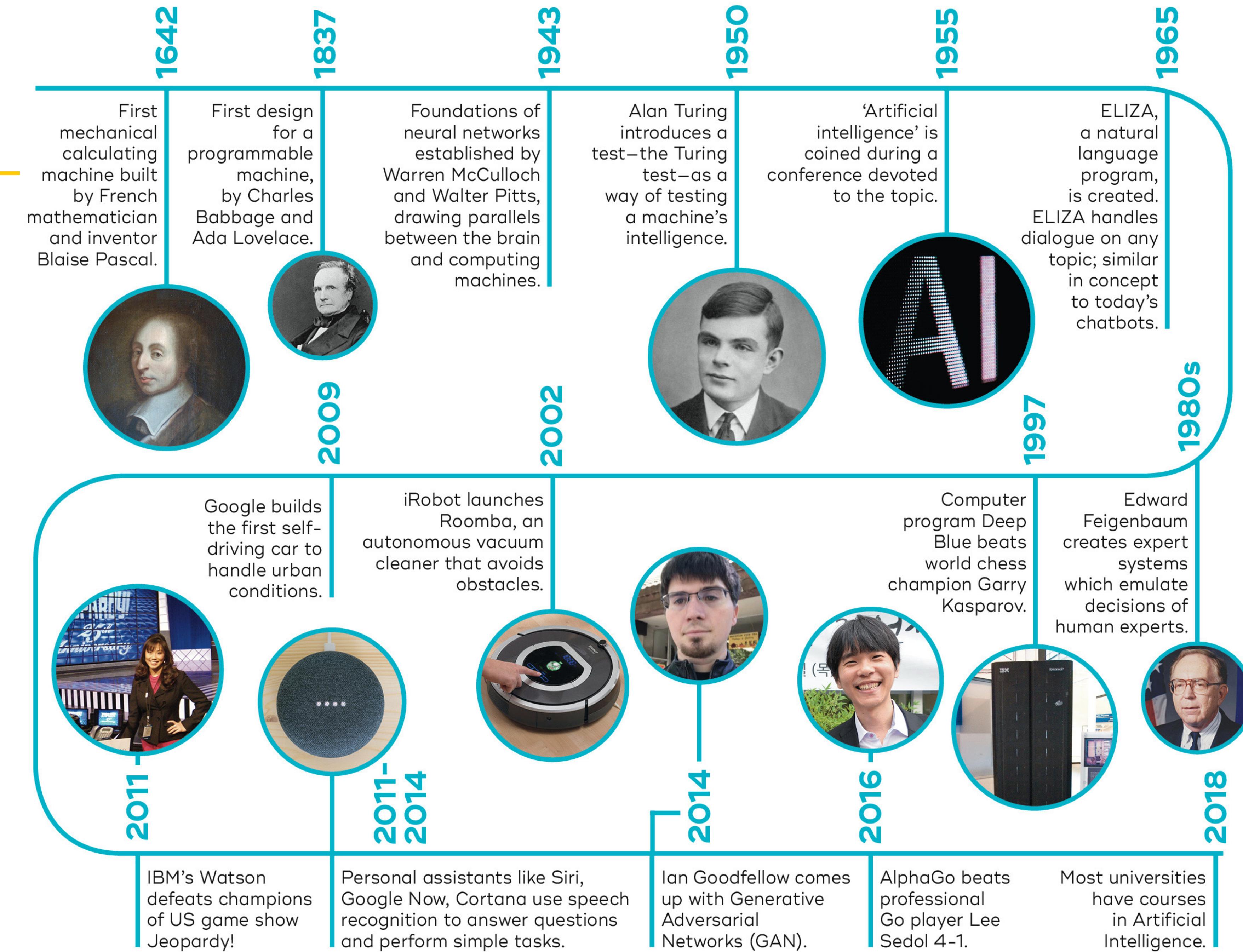
Course Resources

- Website (Everything!)
 - <https://deeprob.org/w24/>
- Canvas (assignments/major announcements)
- Piazza (Course staff help / minor announcements / team collaboration)
 - <https://piazza.com/umich/winter2024/rob498011598012>
- Zoom (Livestream Lectures)
 - <https://umich.zoom.us/j/96524504025>, passcode: deeprob
- Autograder (project grading)
 - <https://autograder.io/web/course/258>
- Pre-Lecture Quizzes (Gradescope)
- Student presentations – multi-modality perception!





How did we get started?



The rise of Robotics and AI

Fueled by advances in computing power and connectivity, the fields of robotics and artificial intelligence have grown rapidly

1921
The term **robot** is first used by Czech writer Karel Čapek



1939
Elektro, a humanoid robot, debuts at the World's Fair, smoking cigarettes and blowing up balloons



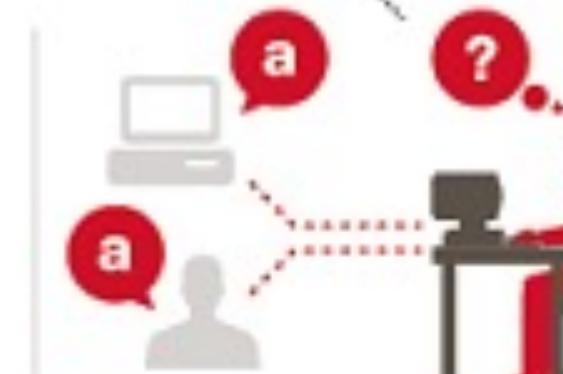
1948
William Grey Walter creates the first autonomous robot with complex behavior

Turing's Test.

It tests a machine's ability to "think" by answering a series of questions. In essence, the tester must think the machine's answers are coming from a human

1941
Isaac Asimov formulates the **Three Laws of Robotics:**

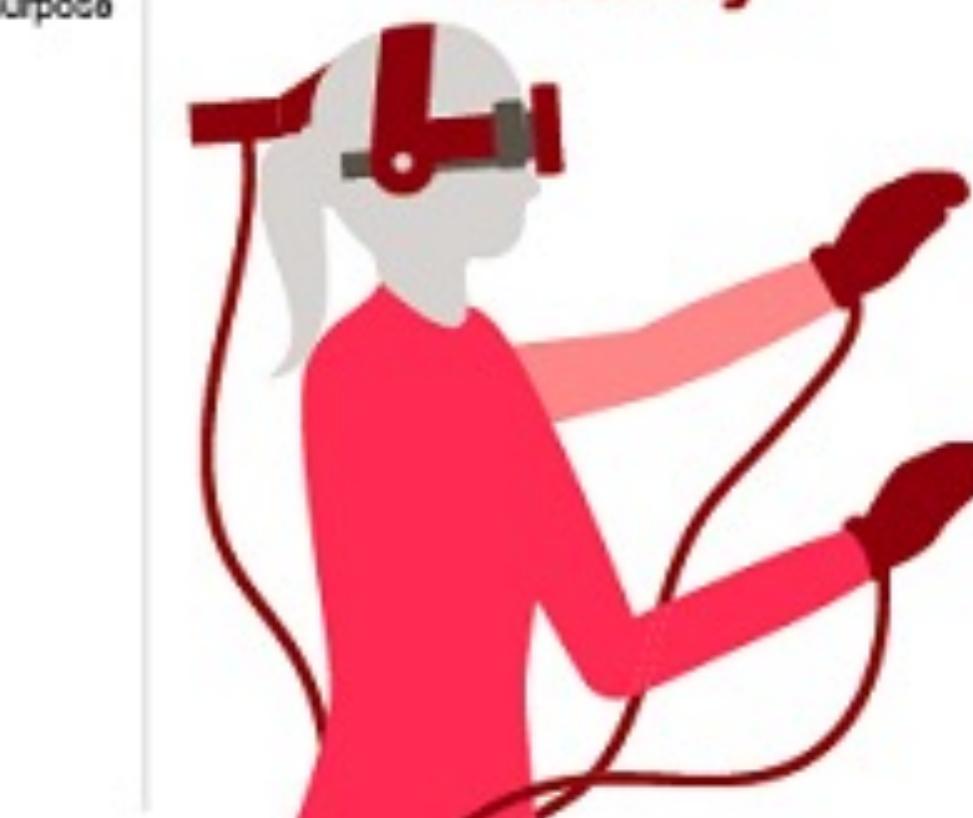
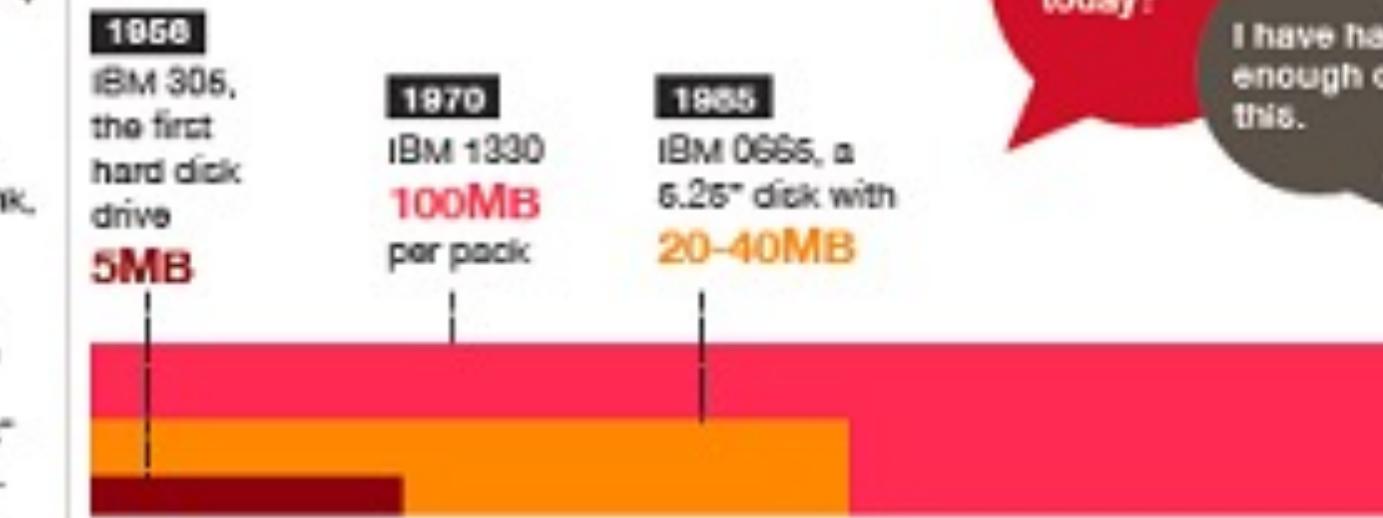
- A robot may not injure a human being or, through inaction, allow a human being to be harmed
- A robot must obey orders given it by human beings except where such orders would conflict with the First or Second Law
- A robot must protect its own existence as long as such protection does not conflict with the First or Second Law



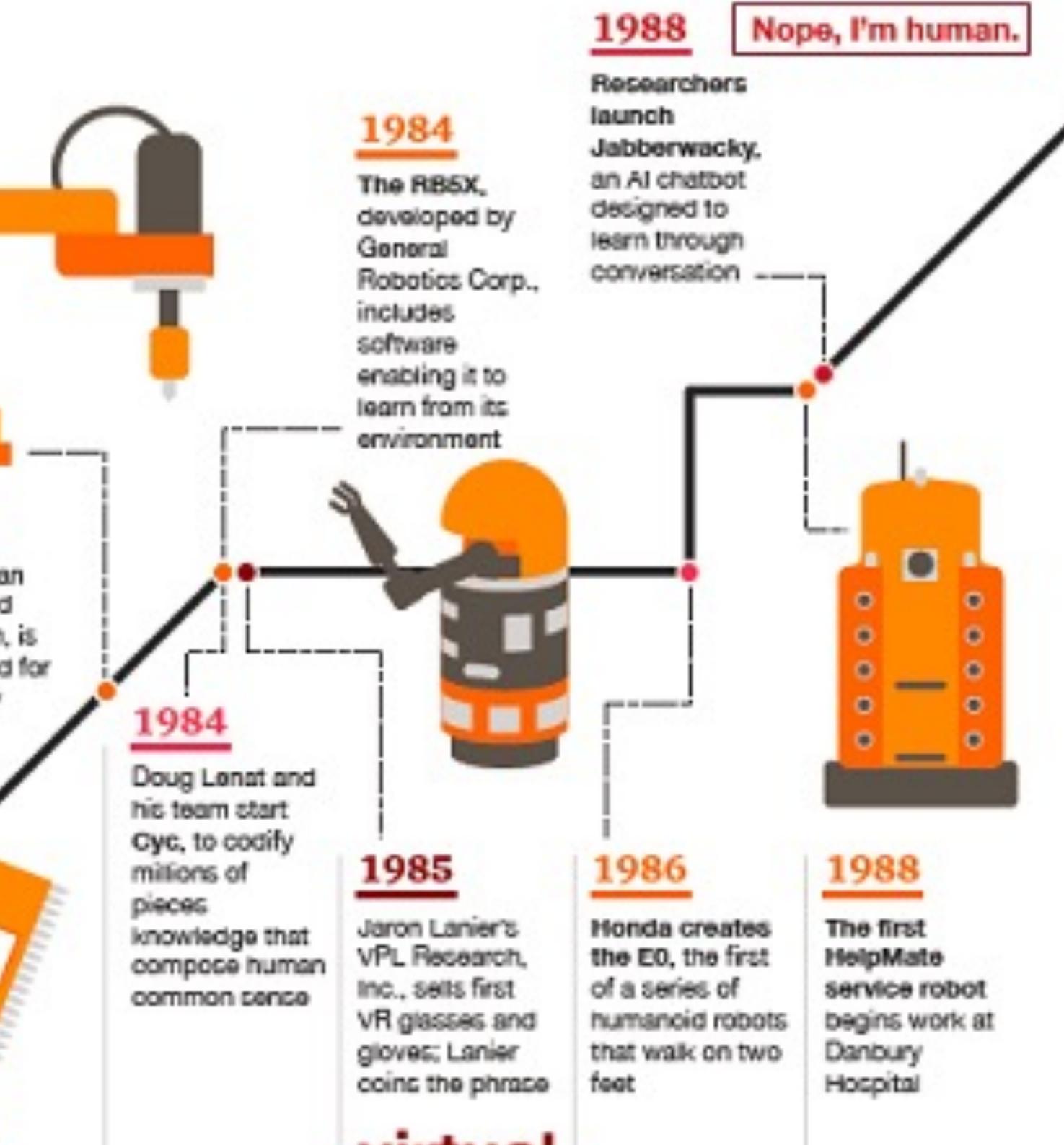
1950
Alan Turing publishes paper about the possibility of machines that think, develops idea known as the

Minimize and maximize

Shrinking disk sizes and exponentially growing capacity help fuel robotics and AI



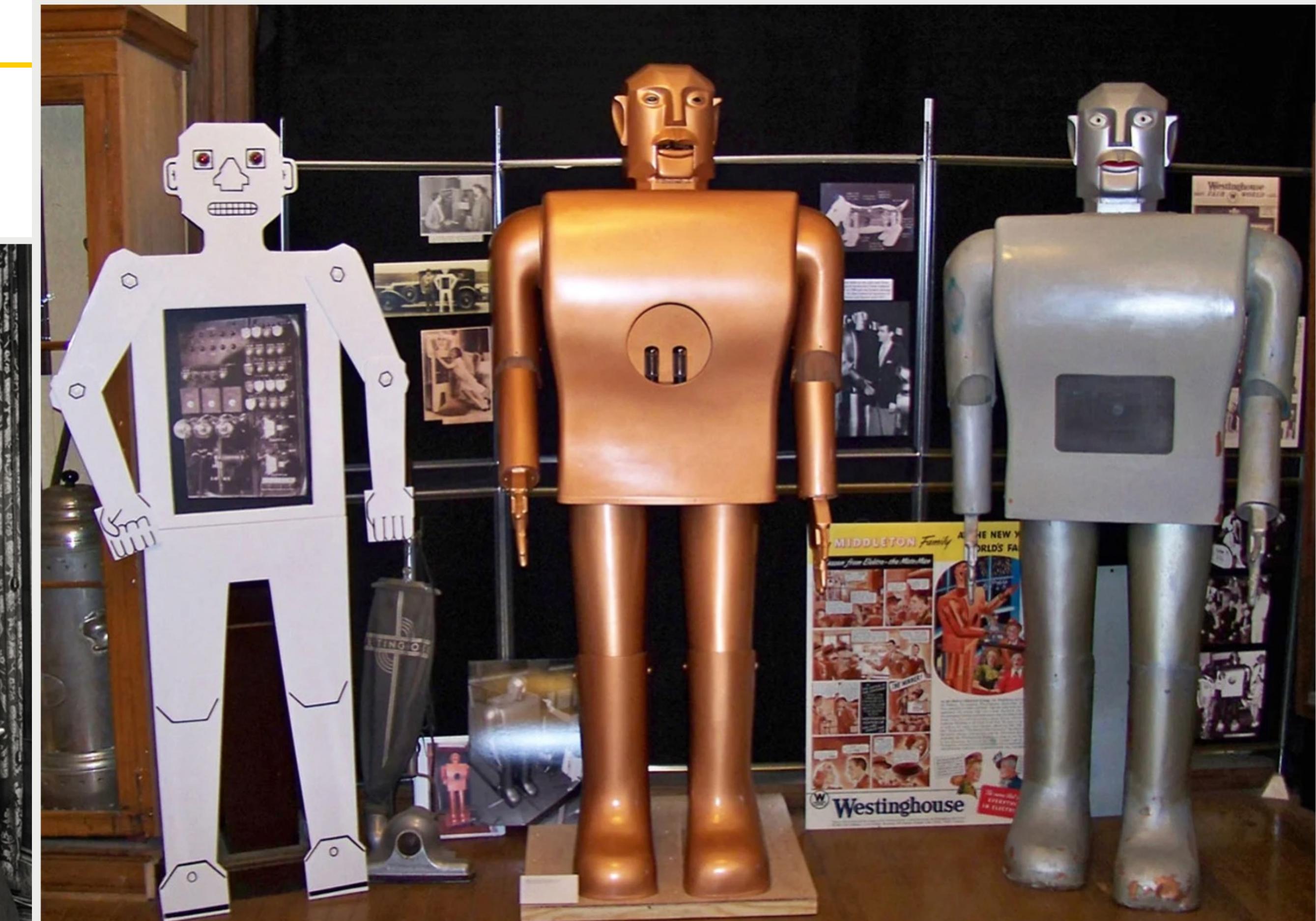
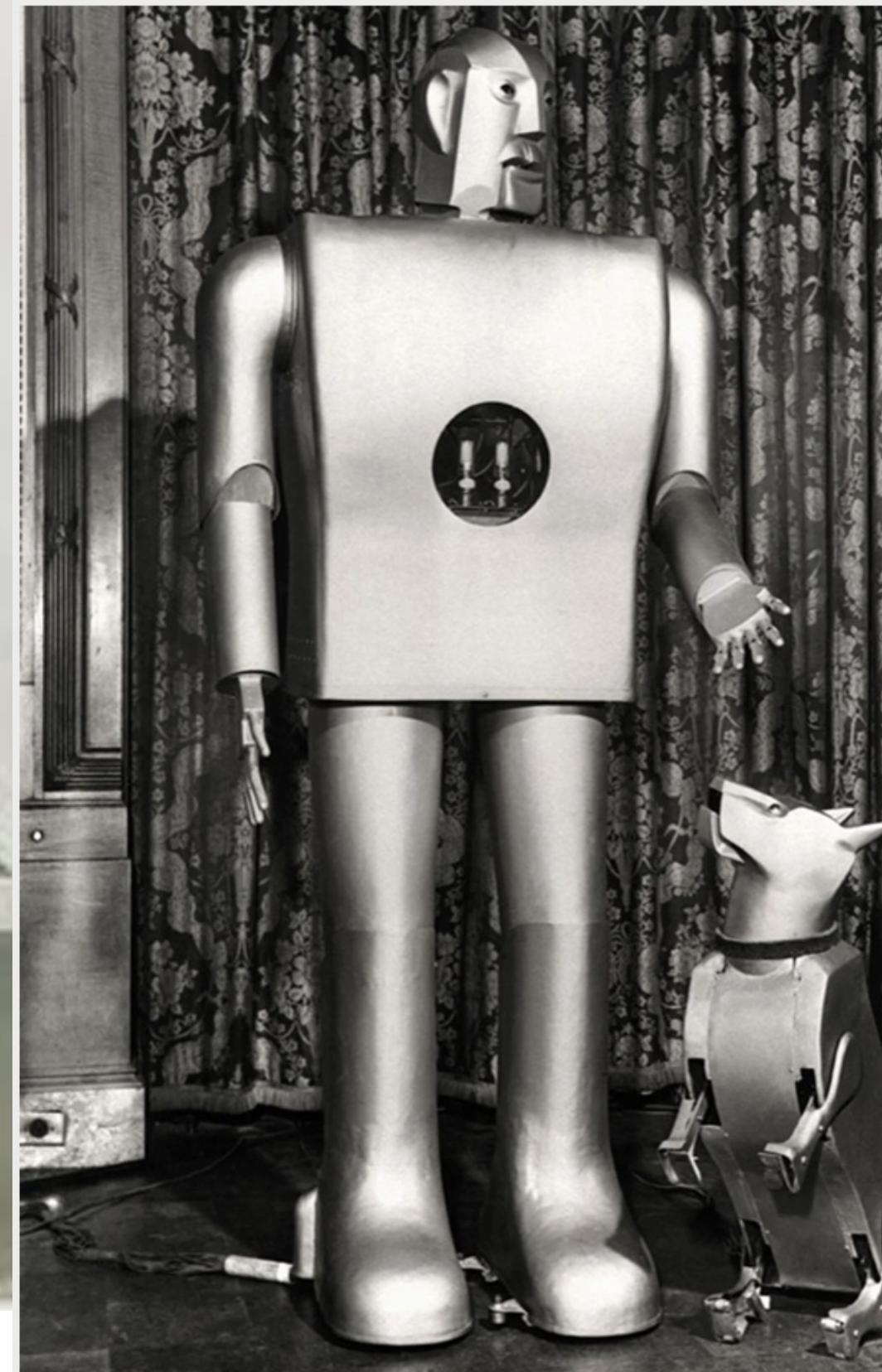
virtual reality



Source: D. Erickson, PWC



Elektro, 1939



Robot Family: Herbert Televox (left) was Westinghouse's first human-form robot. The more famous member of the Westinghouse robot family was Elektro; a copy is shown in the middle, while the original is on the right. PHOTO: MANSFIELD MEMORIAL MUSEUM

Robot's Best Friend: Westinghouse introduced Sparko the dog as a companion for Elektro. PHOTO: BETTMANN/GETTY IMAGES

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1950
Alan Turing publishes paper about the possibility of machines that think, develops idea known as the **Turing's Test.**

1951
Marvin Minsky builds the first neurocomputer, SNARC

1956
IBM 305, the first hard disk drive
5MB

1970
IBM 1330
100MB per pack

1985
IBM 0666, a 6.25" disk with
20-40MB

1954
George Devol invents the first digitally operated and programmable robot



1960
Frank Rosenblatt constructs Mark I Perceptron, a computer that learned new skills by trial and error

1968
Mobile robot "Shakey" is introduced. It's controlled by a computer the size of a room

1979
SCARA, an articulated robot arm, is developed for assembly lines

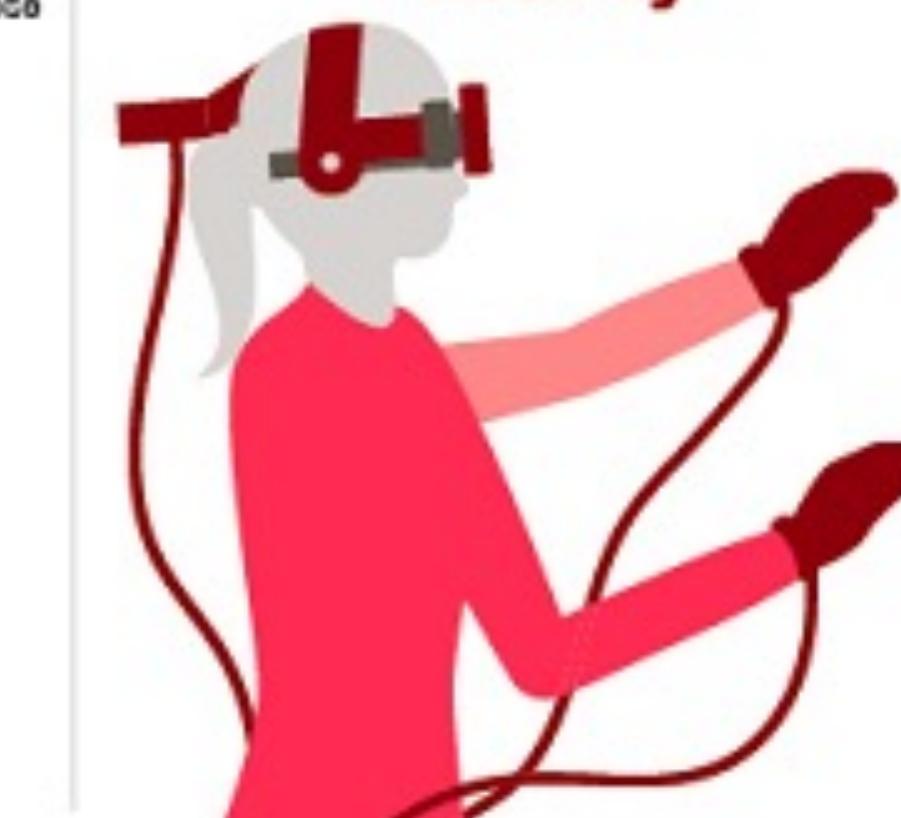
1972
Stanford researcher develops PARRY, designed to simulate a paranoid schizophrenic.

1974
Intel produces its second-generation 8080 general-purpose chips

How are you feeling today?
I have had enough of this.

Minimize and maximize

Shrinking disk sizes and exponentially growing capacity help fuel robotics and AI



virtual reality

1984
The RRSX, developed by General Robotics Corp., includes software enabling it to learn from its environment

1985
Jaron Lanier's VPL Research, Inc., sells first VR glasses and gloves; Lanier coins the phrase

1986
Honda creates the E0, the first of a series of humanoid robots that walk on two feet

1988
Researchers launch Jabberwocky, an AI chatbot designed to learn through conversation

1988
Nope, I'm human.



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NEWS FEATURE | 25 July 2023

ChatGPT broke the Turing test – the race is on for new ways to assess AI

Large language models mimic human chatter, but scientists disagree on their ability to reason.

<https://genai.umich.edu>



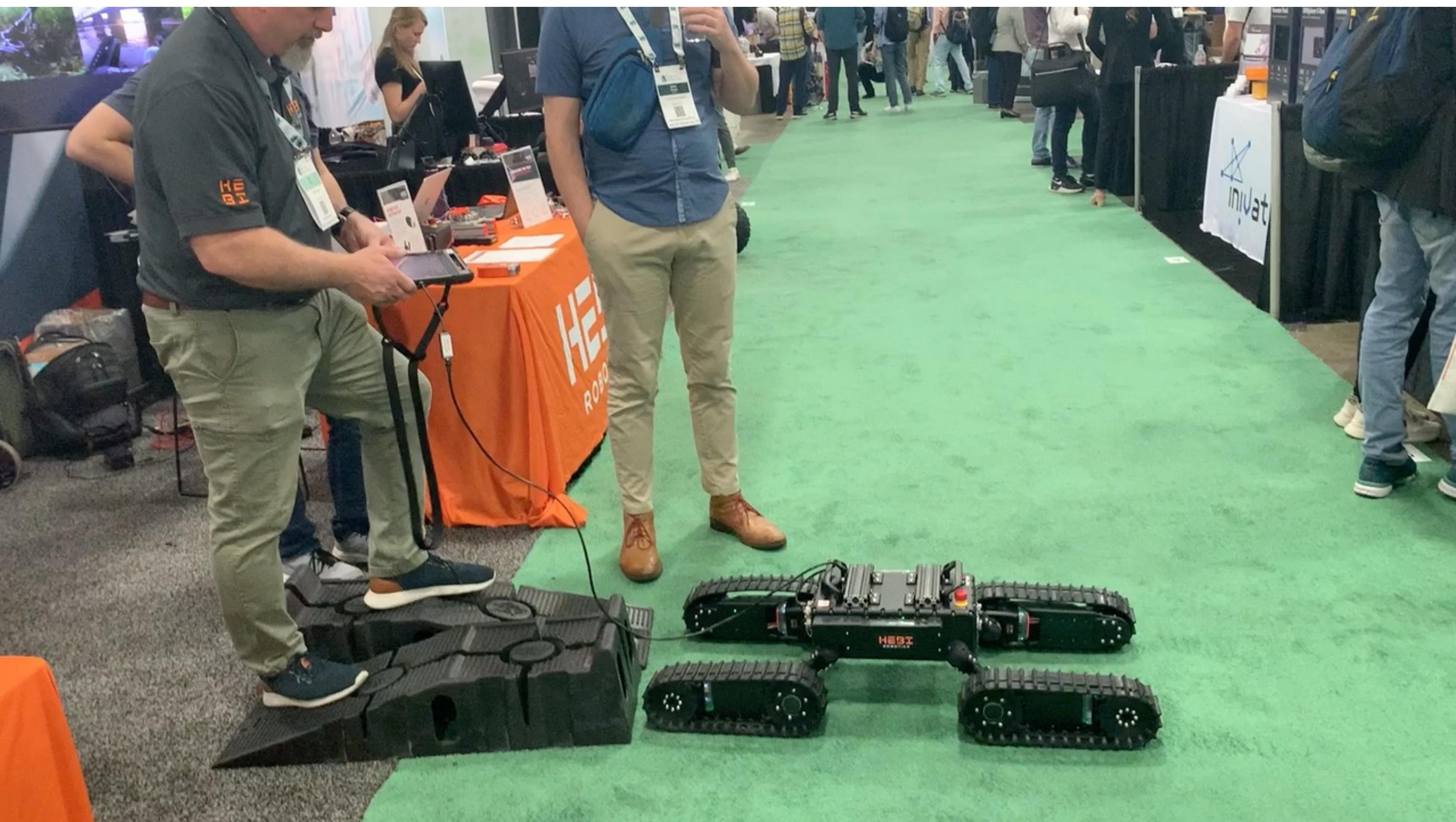
U-M GPT



Where we are now...



Where we are now..





Where we are now..





Deep Learning

Second wave AI:

IEEE SPECTRUM Engineering Topics ▾ Special Reports ▾ Blogs ▾ Multimedia ▾ The Magazine ▾ Projects ▾

Cars That Think | Transportation | Advanced Cars

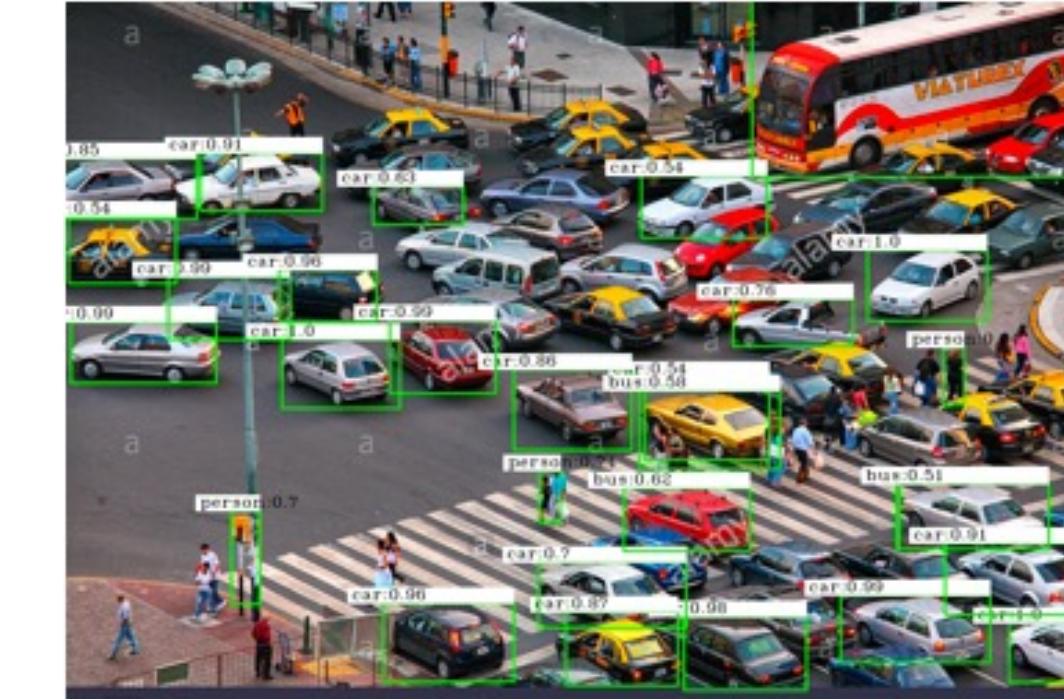
09 Feb 2016 | 17:00 GMT

Deep Learning Makes Driverless Cars Better at Spotting Pedestrians

Pedestrian detection systems for cars could become faster and more accurate with help from deep learning algorithms

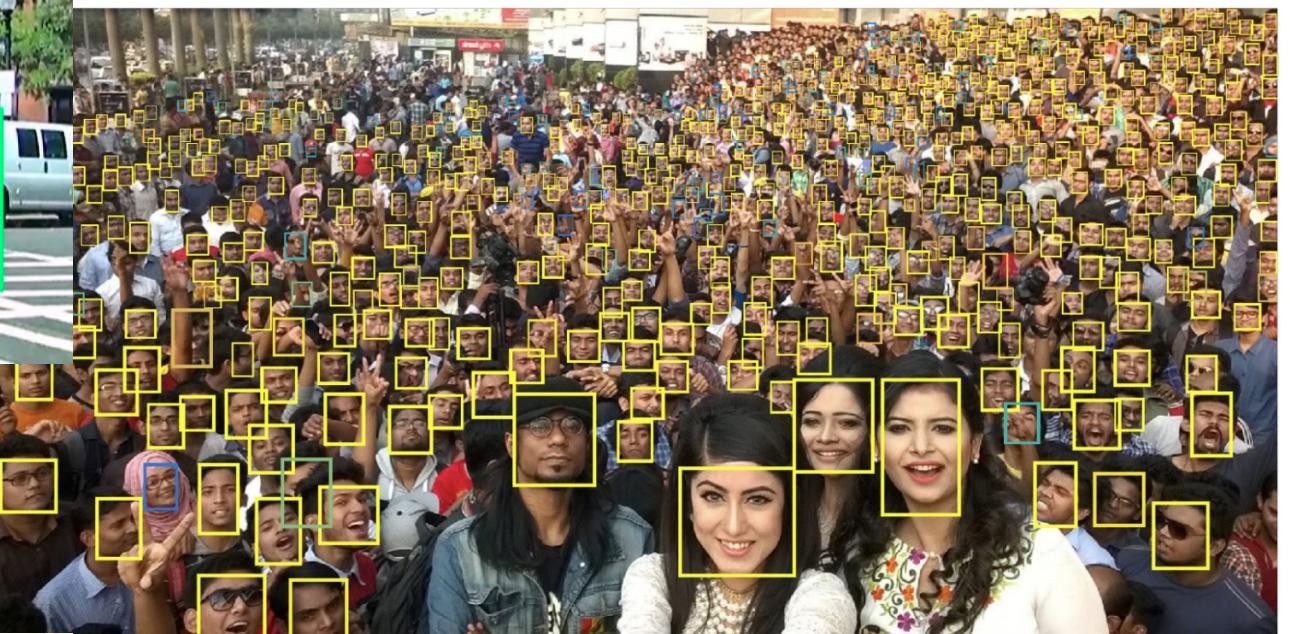
By Jeremy Hsu

Images: Statistical Visual Computing Lab/UC San Diego



Data-driven

“Learn from lots of data”



“deep learning”

1956

2011

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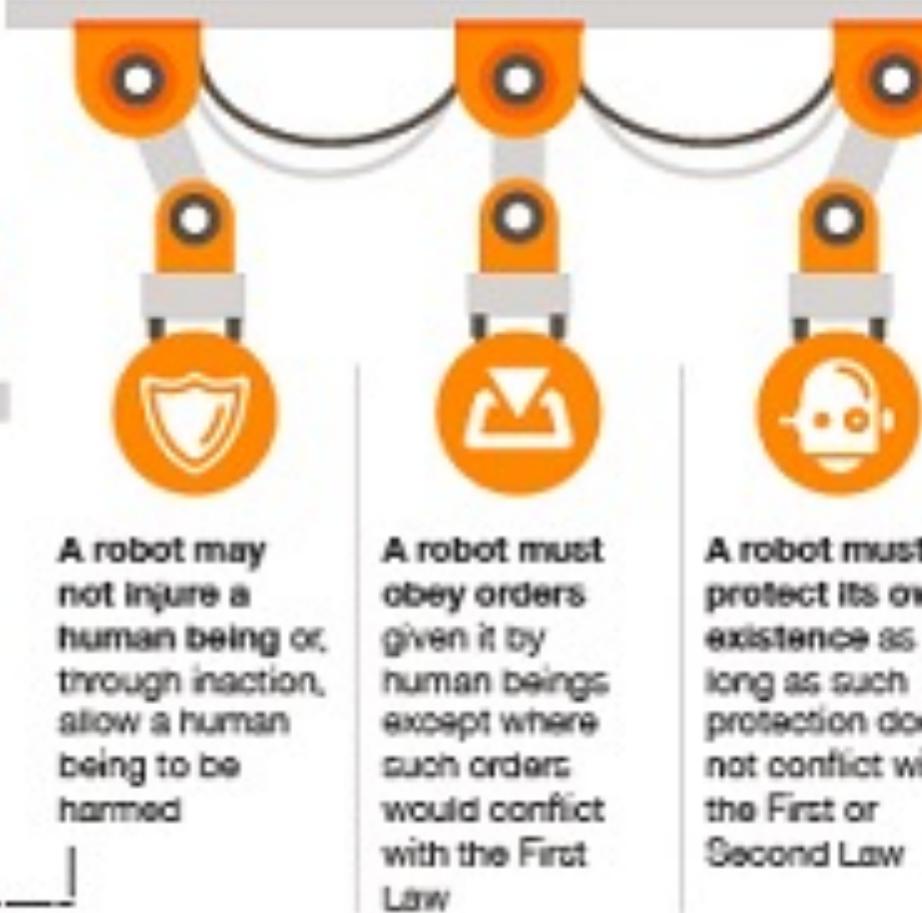
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Three Laws of Robotics:



1956

Field of AI research founded at a conference at Dartmouth

1968

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1960

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1979

SCARA, an articulated robot arm, is developed for assembly lines

1972

Stanford researcher develops PARRY, designed to simulate a paranoid schizophrenic

1974

Intel produces its second-generation 8080 general-purpose chips

1984

Doug Lenat and his team start Cyc, to codify millions of pieces of knowledge that compose human common sense

1984

The RRSX, developed by General Robotics Corp., includes software enabling it to learn from its environment

1985

Jaron Lanier's VPL Research, Inc., sells first VR goggles and gloves; Lanier coins the phrase

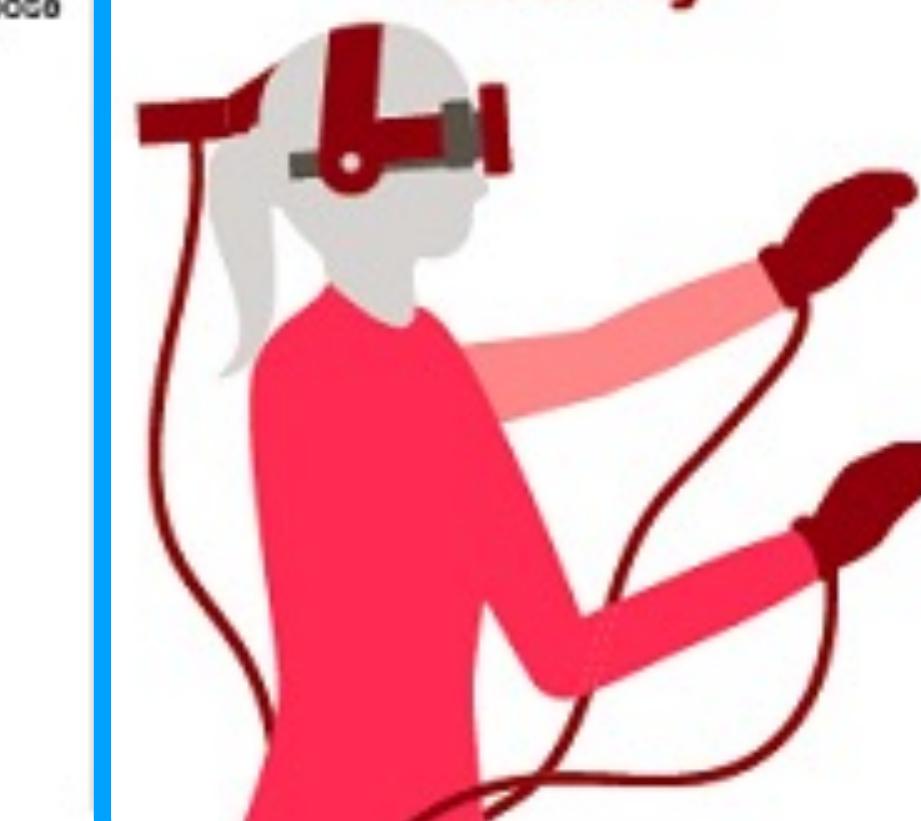
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Researchers launch Jabberwocky, an AI chatbot designed to learn through conversation

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Nope, I'm human.

virtual reality



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IBM 305, the first hard disk drive
5MB

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IBM 0666, a 6.25" disk with
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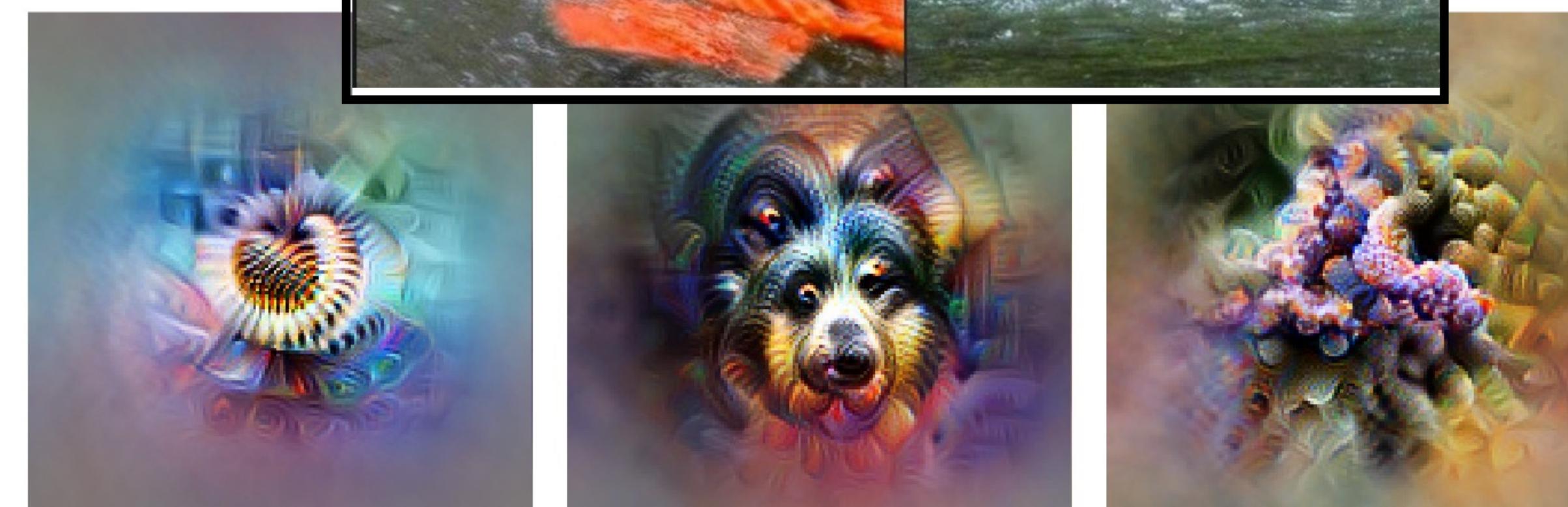
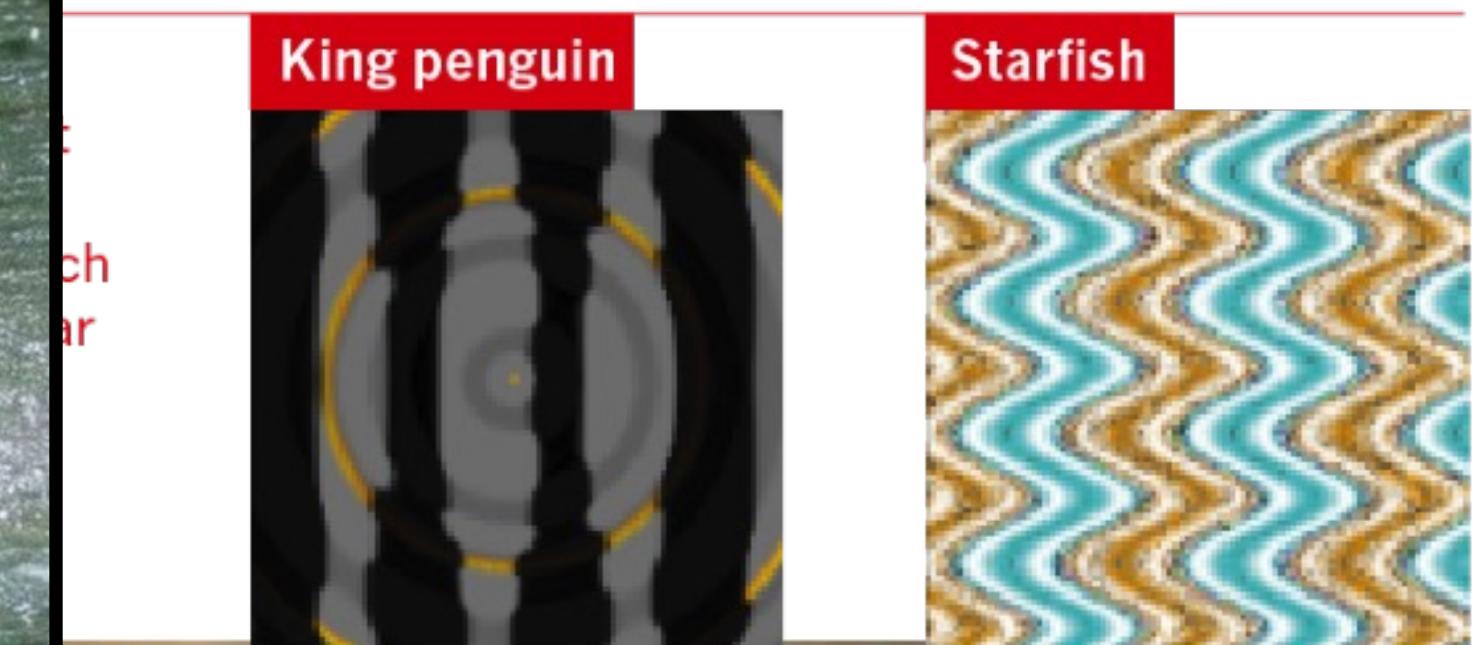
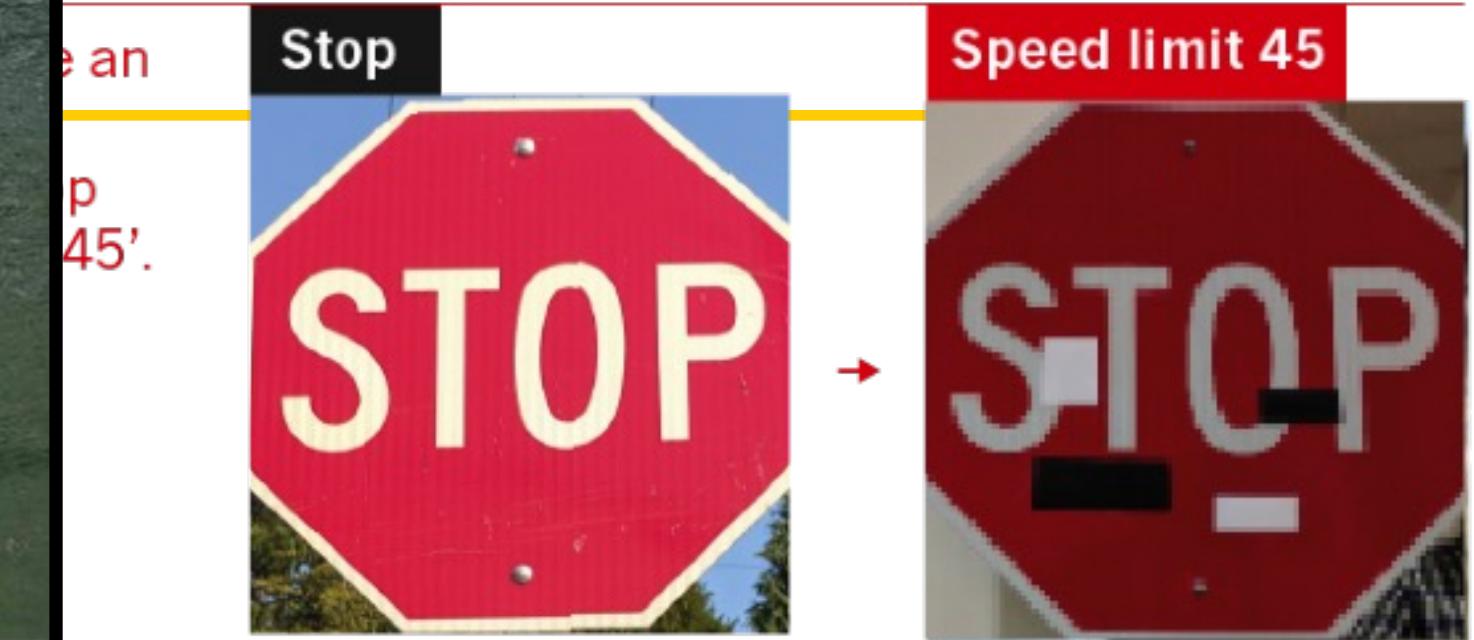
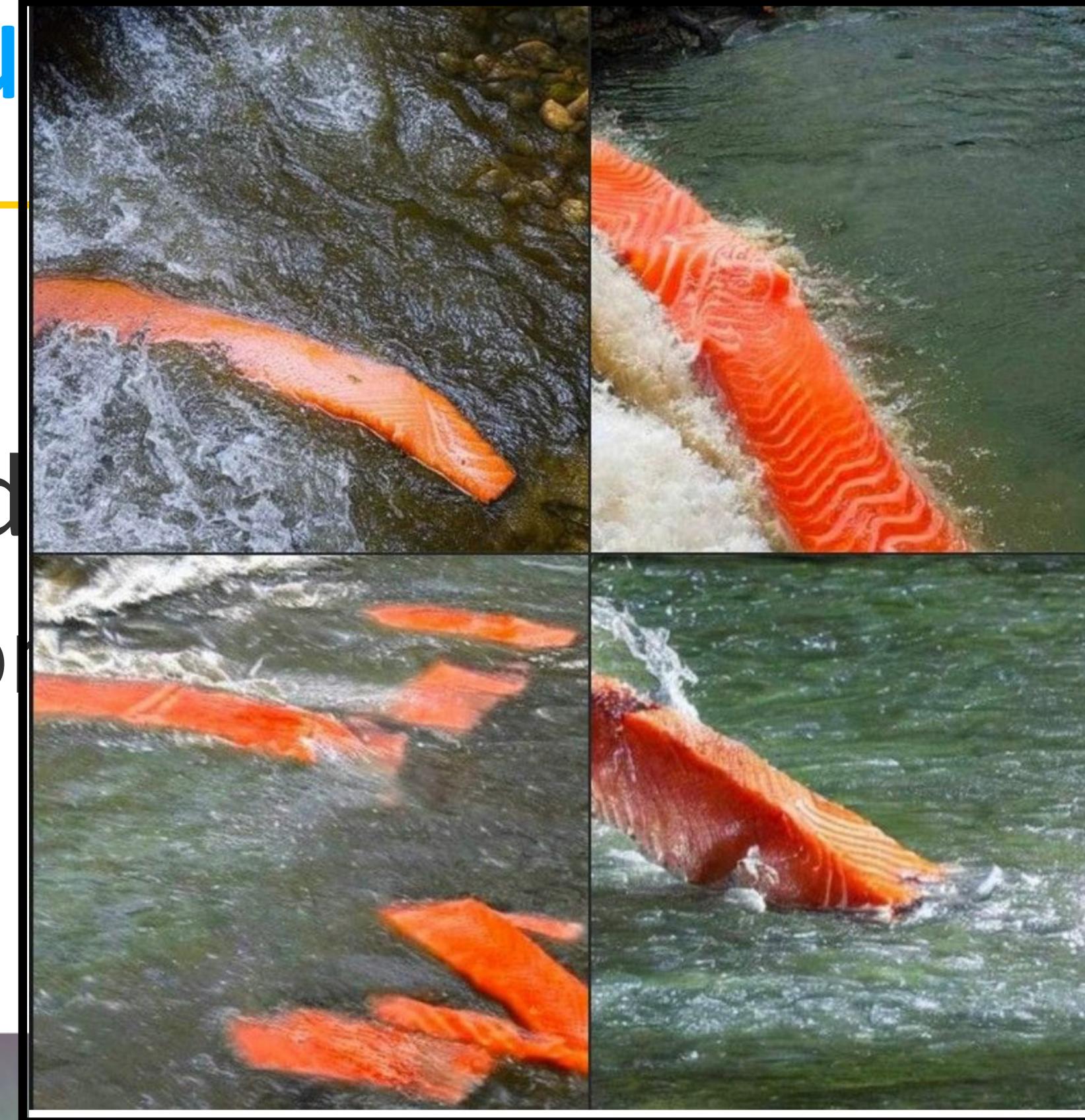


Some Issues

- “Easy to fool”
- Large volume of data
- Limited annotation
- Ethics
- ...

FOOLING THE AI

Deep neural networks (DNNs) are brilliant at image recognition, but they can be easily hacked.



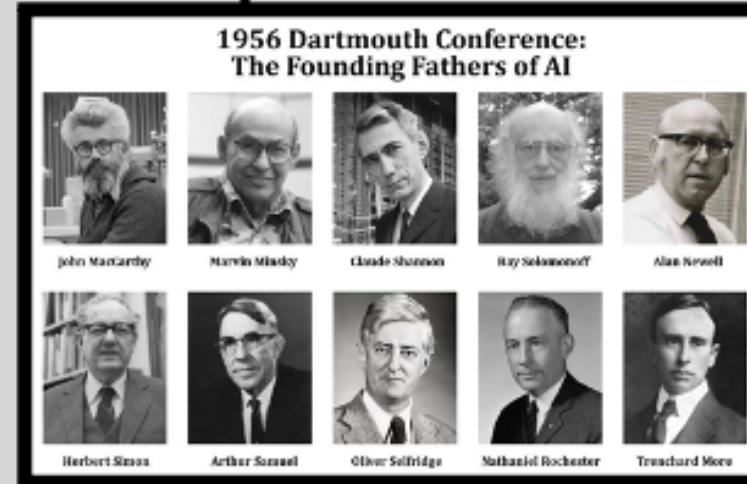
©nature



Other Robotics and AI courses

First wave AI: Model-based

“Think through the entire problem”

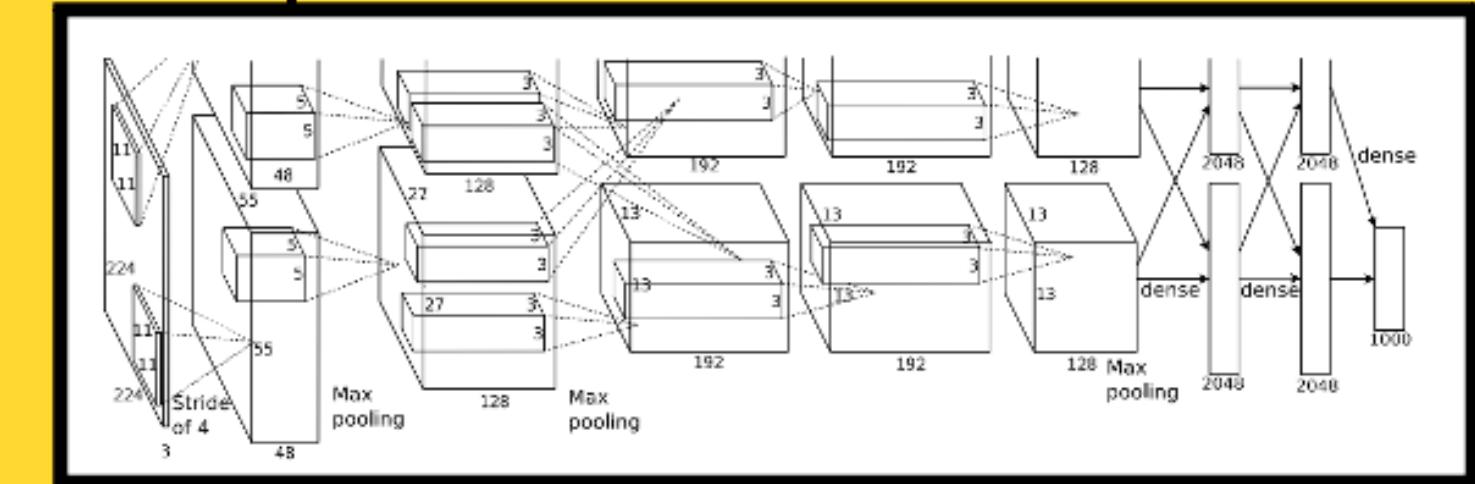


1956

DeepRob is a step into modern robot learning

Second wave AI: Data-driven

“Learn from lots of data”

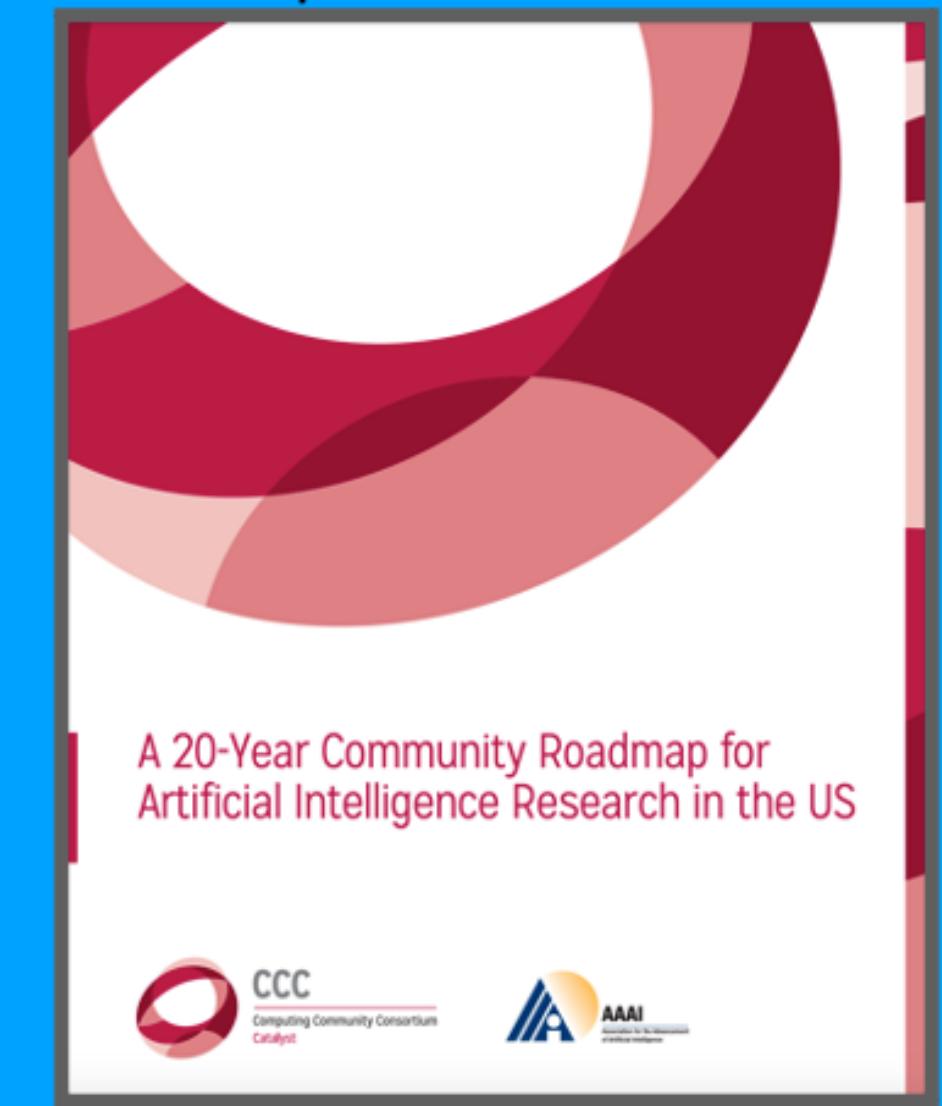


2011

Research for future AI

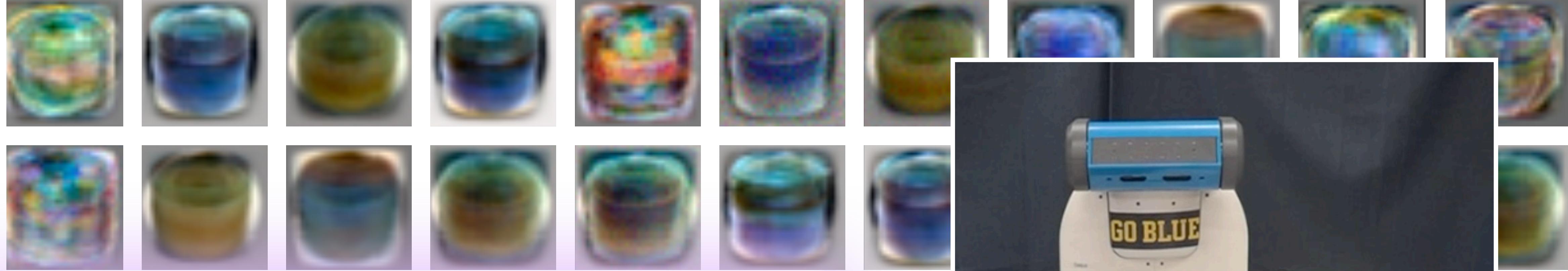
Third wave AI: Explainable

“Combine first and second wave AI to generate explanations”



20??

Time



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